

**REMARKS**

Claims 29-54 are pending in this case; claims 29 and 41 are the only independent claims. In the Office Action dated October 30, 2008, the claims were rejected under 35 U.S.C. §103(a) as unpatentable over US5932086 (Kasaian) in view of US3301777 (Leonard). Applicant maintains that the Examiner has misperceived either Kasaian or applicant's claimed invention (or both), and requests reconsideration based on the arguments set forth below.

Applicant would like to thank the Examiner for the courtesies extended during the telephonic interview conducted with applicant's undersigned counsel on January 21, 2009, in which the prior art was discussed, specifically, the Kasaian patent upon which the rejection of applicant's claims is primarily based.

As the Examiner is well aware, leaching is a widely used extractive metallurgy technique by which metals are converted into soluble salts in aqueous media. For metals in oxide form, leaching reactions are conventionally carried out using sulphuric acid, such that the insoluble metal oxide is converted into a soluble metal sulphate. Kasaian is typical of this type of reaction, but his process is suitable for leaching only a

particular oxide of manganese, specifically, manganomanganic oxide ( $Mn_3O_4$ ).

Kasaain's specification begins with the statement that his invention relates to a process "wherein a source of manganomanganic oxide ( $Mn_3O_4$ ) is treated in a leach solution in the presence of a reducing agent to convert the manganomanganic oxide to manganese sulfate" (column 1, lines 9-12). Kasaaiian then more specifically summarizes his invention as follows:

Broadly, the present invention is an improvement to the electrolytic process for making manganese wherein *a sulfuric acid leach solution* is used to convert a source of manganese oxide to manganese sulfate, the improvement comprising replacing said source of manganese oxide with a source of manganomanganic oxide *in the sulfuric acid leach solution*, and *adding a reducing agent to said leach solution* in an amount effective to reduce the manganomanganic oxide to manganese oxide.

(column 1, line 66 through column 2, line 7; emphasis added). Thus, Kasaaiian's process utilizes a typical sulphuric acid leach solution, but adds some other agent to reduce the starting material, manganomanganic oxide ( $Mn_3O_4$ ), to a different oxide of manganese, namely, manganese oxide ( $MnO$ ). Clearly, Kasaaiian contemplates that this reduction must take place before the leaching reaction, by which sulphuric acid then converts the manganese oxide to the expected leach reaction product, manganese sulphate ( $MnSO_4$ ).

Kassaian goes on to confirm this in the "Detailed Description of the Invention" portion of the reference. Specifically, at column 2, lines 12-20, he states that

The present invention is directed to a process for making manganese or manganese dioxide comprising the steps of:

(a) leaching a source of manganomanganic oxide ( $Mn_3O_4$ ) with a sulfuric acid solution and a reducing agent, said reducing agent being present in an amount effective to reduce said manganomanganic oxide to manganese oxide ( $MnO$ ), and said sulfuric acid being present in an amount effective to lower the pH to 3 or below and convert said manganese oxide to manganese sulfate;...

(emphasis supplied.) It should be noted that, at this point, Kasaian has not yet disclosed any reducing agents that are suitable for use in his process, but it is clear once again that sulphuric acid is being used to carry out the leaching reaction itself, so as to convert an oxide of manganese to manganese sulphate.

Kasaai later confirms this once again, at column 3, lines 17-20, wherein he states that the "*leach step is conducted using a sulfuric acid solution in an amount effective to lower the pH of the leach solution containing the source of manganomanganese oxide and reducing agent to about 3 or below*" (emphasis supplied). Here, Kasaai also makes clear that the sulphuric acid is added to a "leach solution" that already contains a reducing agent. Further, Kasaai states that "[t]heoretically, any acid can be used in the leach step, e.g. hydrochloric acid, however, sulfuric acid is

readily available and used commercially" (column 3, lines 22-24).

Thereafter, Kasaian goes on to disclose, at column 3, lines 25-29, suitable reducing agents, and he states that suitable ones include sulphur dioxide ( $\text{SO}_2$ ), a reducing sugar, molasses, and carbon (Kasaian later clarifies the latter as "activated" carbon (column 3, line 47)), although sulphur dioxide is Kasaian's preferred reducing agent because it is readily available. Kasaian states that the "amount of sulfur dioxide added to the leach solution is based on the stoichiometric amount *necessary to reduce manganomanganic oxide to manganese oxide (MnO)*" (column 3, lines 31-34), once again confirming that the function of the reducing agent is not to carry out the leach, but to reduce manganomanganic oxide ( $\text{Mn}_3\text{O}_4$ ) to manganese oxide (MnO), so that the latter can then be converted by the sulphuric acid to manganese sulphate in the leaching reaction.

Although Kasaian does not specifically describe the reduction reaction effectuated by the sulphur dioxide, it is believed that one of ordinary skill in the art would understand that the reduction process would be represented by the following equation:  $2 \text{Mn}_3\text{O}_4 + \text{SO}_2 \rightarrow 6\text{MnO} + \text{O}_2 + \text{SO}_2$ . Thus, since the sulfur dioxide is not used up, but is actually regenerated in this preliminary reaction step, the sulfur dioxide is essentially

functioning as a catalyst, and is not "participating" at all; the sulfur dioxide plays no direct role in the subsequent leaching step by which the manganese sulphate reaction product is formed, and it clearly does not function as the leaching agent.

With all of the foregoing background information and explanatory disclosure, it is difficult to imagine that Kasaian would later contradict himself in the same document. Yet in the Office Action, the Examiner relies on Kasaian's Example 1 (in columns 4 and 5) for the proposition that he discloses a leach process that uses "sulfuric acid with sulfur dioxide bubbled through the tank," from which the Examiner infers that both the sulphur dioxide AND the sulphuric acid are somehow involved in the leaching reaction itself, or that both function as the leaching agents. This is a misapprehension of Kasaian's teaching, and it exalts form over substance to insist that in Example 1, Kasaian is disclosing a *different* function for the sulphur dioxide than that which he discloses over and over again elsewhere, in the more general, prefatory portions of his patent.

Thus, the Examiner's basic contention, that the "Kasaian patent discloses [except for some details provided by the Leonard patent] the claimed method for the hydrometallurgical processing of manganese containing materials" is not correct. It is

clear from Kasaian's disclosure that the leaching reaction itself is conducted with sulphuric acid, not with sulphur dioxide; this is fundamentally different from the leach of the present invention, in which the leaching reaction is conducted with sulphur dioxide.<sup>1</sup>

Indeed, applicant has recognized that by using sulphur dioxide as the leaching agent, a preliminary step that is required by Kasaian's process can be eliminated. Specifically, since Kasaian's process is suitable for leaching only a particular oxide of manganese, specifically, manganomanganic oxide ( $Mn_3O_4$ ), he makes clear that in order to use his process in the leaching of other (lower) oxides of manganese ( $MnO_2$  or  $Mn_2O_3$ , for example) a preliminary step is required, namely, to convert these lower oxides first to manganomanganic oxide, by sintering (see column 2, lines 47-49 of Kasaian, where he states that, at the outset, "[s]intering of manganese ore is performed to convert all of the lower oxides of manganese, e.g.  $MnO_2$  and  $Mn_2O_3$  to manganomanganic oxide ( $Mn_3O_4$ )").

In contrast, in applicant's process, by using sulphur dioxide (rather than sulphuric acid) as the actual leaching agent, the lower oxides of manganese can be leached directly, without any pretreatment step (such as sintering) to convert those oxide(s) to a

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<sup>1</sup> This is made clear in applicant's specification, page 2, lines 19 to 21, and page 7, lines 1-6.

different form. Applicant's leaching reaction, which can be represented by the equation  $MnO_2 + SO_2 \rightarrow MnSO_4$ , is carried out in the presence of sulphuric acid, but the sulphuric acid does not itself participate in the leaching reaction at all. Rather, sulphuric acid is used in the leach merely to maintain the pH of the reactants at 1.5 or less, so as to inhibit thionate and dithionate ion formation,<sup>2</sup> but any acid could be used (see, for example, page 4, line 15 of applicant's specification ["in acidic solution"]) - sulfuric acid is noted as being the preferable acid merely because it can be recycled from the electrowinning stage (see page 5, lines 17-20). It is the sulphur dioxide that drives the reaction to sulfate formation, not the acid -- the acid does not itself take part in the reaction, but simply acts to inhibit thionate and dithionate formation, while at the same time, as a side benefit, acting *like* a catalyst to enhance sulphate formation.

There is no disclosure, suggestion or teaching in the Kasaian patent that sulphur dioxide can or should be used as the leaching agent itself, as disclosed and now claimed by applicant. Thus, the Examiner's reliance on Kasaian as the primary

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<sup>2</sup> As noted on page 7, lines 13-19, of the specification, higher pH values favor the production of dithionate ions, whereas lower pH values help to minimize the formation of dithionate ions and ensure that the production of manganese sulphate (rather than manganese dithionate) becomes the predominant reaction in the leach, thereby yielding the advantages set forth on page 2 of applicant's specification. As indicated elsewhere in the specification, however, other techniques can also be utilized to help minimize the production of dithionate ions, including effective monitoring of the oxidation-reduction potential, and of the additions of manganese dioxide and sulphur dioxide to the reaction mixture.

reference in the outstanding rejection is inapposite, and therefore applicant maintains that any teaching in the Leonard patent relating to "adjusting" the amount of dithionite is irrelevant. Nevertheless, applicant also maintains that the clear implication of Leonard, in the passage beginning in column 4, at line 33, is that dithionite can be introduced into the reaction mixture as a starting material, despite his use of the words "operating variables" in the opening sentence of that paragraph. Leonard's use of the phraseology "If desired ... a reducible sulfur compound such as dithionates ... can be included in the electrolyte" (column 4, lines 39-42) could only be interpreted by a person of ordinary skill as a suggestion that dithionite can be affirmatively added to the mixture (otherwise, how else would it get there?). Leonard's use of the words "can be included" must be taken as synonymous with "can be added" given the surrounding context.

In, applicant's claimed method, the dithionite ions are products (or, more aptly, by-products) of the leaching reaction, and therefore, it is the amount of dithionite formed as a reaction product, *not* the amount used as a starting material, which applicant has realized must be controlled, in the context of a leach reaction for manganese containing materials that utilizes sulphur dioxide, not sulphuric acid, as the leaching agent. There is certainly no teaching in either Kasaian or Leonard which suggests that low levels of dithionite ion is a desirable outcome.

For all of the foregoing reasons, the rejection of the claims under 35 U.S.C. §103(a) as unpatentable over Kasaian in view of Leonard should be withdrawn, and this application should be passed to issue.

Applicant has responded herein to the points raised by the Examiner in the Office Action. Accordingly, further favorable action in connection with this patent application is earnestly solicited. The Examiner is invited to contact the undersigned attorney by telephone if it will advance the prosecution of this case.

Respectfully submitted,

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